PROJECT IDENTIFICATION
TOWN OF GOSHEN
MILL CREEK AND CALFPASTURE RIVER CONFLUENCE

Location Description
37.98634, -79.49412
Confluence of Mill Creek and Calfpasture River near the Route 42 railroad crossing at the eastern end of town; natural narrowing of the Calfpasture channel at the point where Mill Creek discharges; low-water bridge on Maury River Road.

Project Issue
River channel hydraulic restriction — natural choke point where simultaneous high flows from Mill Creek and the Calfpasture River combine, backing water up through the entire town; channel noted by Town staff as regularly obstructed by accumulated logs, debris, overgrowth, and a log jam at an old water control structure on the Mill Creek approach; EPA currently authorizes clearing only — widening and deepening are not authorized.

Project Purpose
Alleviate the primary hydraulic choke point at the Mill Creek/Calfpasture River confluence to reduce flood depths and duration for the entire Town of Goshen and maintain emergency access routes.

Identified Constraints
a. Surrounding infrastructure
b. Coordination with VDOT for work around roads/bridges
c. Railroad tracks and coordination
d. EMS access needs
e. Bedrock restriction in channel bottoms

Additional Information Needed
a. FEMA flood study data and results
b. Rate of channel debris accumulation
c. Presence of utilities
d. Nature and current status of noted EPA restriction on channel modification

Project Proposal and Planning-Level Cost Estimate
The Town of Goshen is situated within the floodplain of the confluence of Mill Creek and the Calfpasture River, with portions of the Town in the regulatory floodway (**Figure 1**). Particularly when flows are high in both Mill Creek and Calfpasture River, significant portions of town flood.

Mill Creek has been noted by Town staff as particularly susceptible to debris jams, culminating at a low bridge on Maury River Road crossing the stream at a steep angle directly beneath the railroad tracks (**Figure 2**, **Figure 3**). The routine flooding of this low bridge was noted as a particular concern as the crossing is utilized by emergency vehicles to access the northern portion of the town when train cars may be blocking the primary route (Main Street/VA 39 Alt.). To address these flooding and evacuation concerns in the Town of Goshen, the Town has periodically removed debris from the channel. This might increase the velocity and flow in the channel, creating a slightly more efficient channel. Removal of debris within the stream would also decrease the chances of objects blocking flow between bridge piers, creating backwater during floods. The increase in conveyance would work to decrease the flood extent and severity. A maintenance schedule should be created for Town officials or others to remove debris from the channel regularly if not already developed. Additionally, renewed collaboration with the railroad entity(ies) should be pursued to minimize the amount of time Main Street is blocked by train cars, given the safety concerns.

The existing FEMA flood study and any other flood analysis already completed relating to the confluence should be evaluated and an updated study completed if warranted. The effective FEMA FIRM appears to be dated 2000, and as such would not have benefited from the recent advances in 2D hydraulic modeling to better simulate complicated systems such as confluences. A detailed 2-D hydraulic model of the confluence area could be used to develop a targeted debris management strategy that may actually use some of the debris, anchoring it to increase flow efficiency and sediment transport to alleviate the maintenance burden while also controlling flooding.

Based on limited historic aerial imagery (via Google Earth), it appears that the confluence changed sometime between 2011 and 2013 from Mill Creek joining Calfpasture at a single junction to Mill Creek splitting into 3+ flow paths among islands of deposited cobble prior to joining Calfpasture (**Figure 4**). This could be due to natural channel processes or possibly some previous channel work. Town staff noted that some clearing of vegetation has been completed in the past, which could lead to re-working of deposits previously anchored by root systems. This opens the possibility that increased channel stability at the confluence could return some sediment transport capacity that may have been lost. This could be verified and explored with the proposed 2D hydraulic model. The point bar at the confluence running between the two streams could be stabilized. Installing a structure, such as a cross vane, along Mill Creek downstream of the low bridge would help re-establish and reinforce a single channel along Mill Creek. Redirection of energy from the banks and towards the center of the channel would mobilize sediment and decrease deposition. Construction of the low flow channel would reduce the probability that the channel is filled with sediment and other debris. These alterations would also make the debris management easier on Town staff.

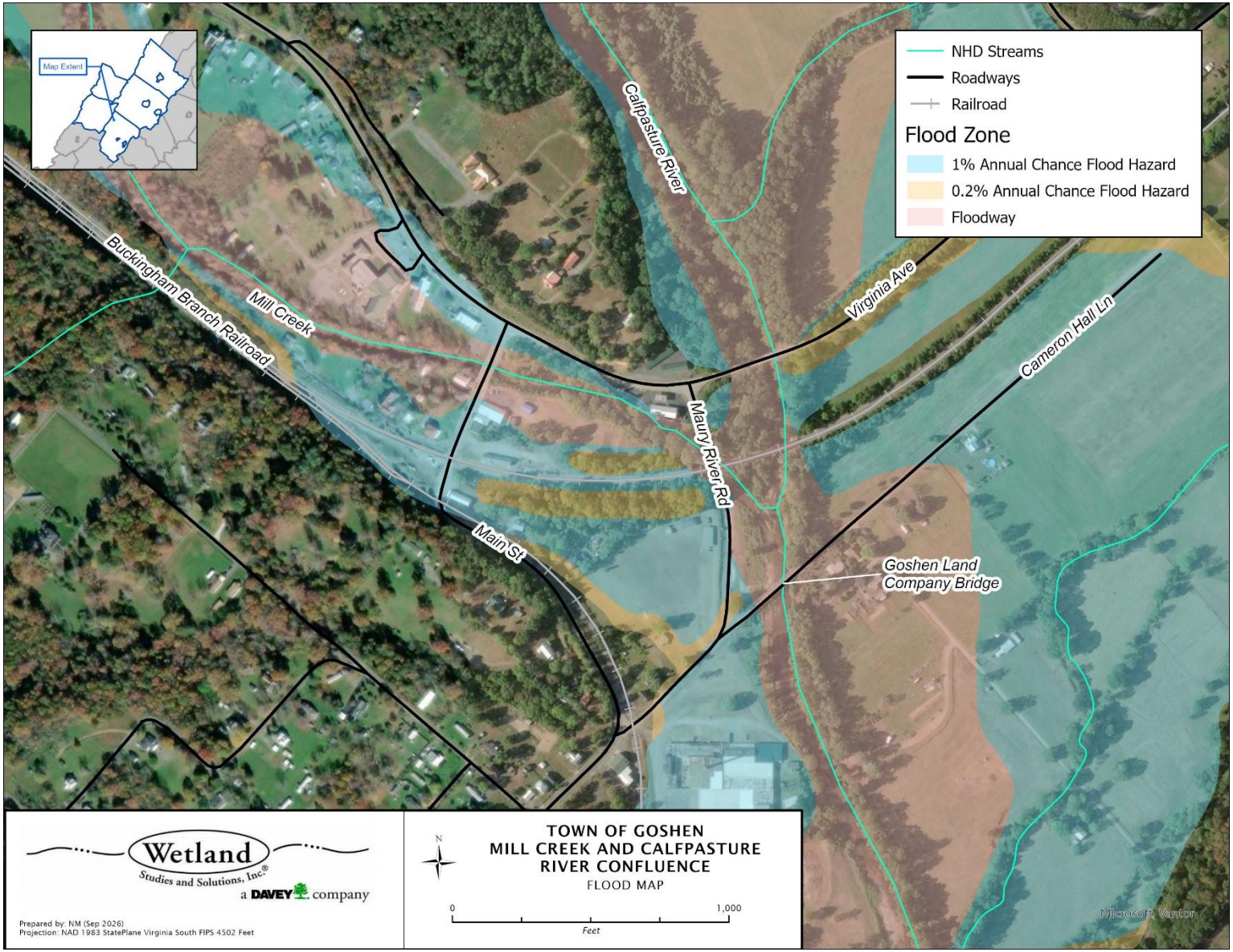

Figure 1. Map displaying the confluence of the Calfpasture River and Mill Creek in the Town of Goshen. Flood zones are displayed, showing areas of severity.



Figure 2. Maury River Road and Buckingham Branch railroad bridge spanning Mill Creek. Photograph taken facing upstream (approximately northwest).



Figure 3. Low bridge on Maury River Road across Mill Creek. Photograph taken facing downstream (southeast).



Figure 4. Photograph of the confluence of the two streams – Calfpasture River flowing along right, Mill Creek entering from left. Existing depositional bar can be seen between them. Photograph was taken from the Goshen Land Company bridge, facing upstream (approximately north).

ITEM/DESCRIPTION	QTY	UNIT	UNIT COST	ITEM SUB-TOTAL	EXTENDED SUB-TOTAL
Phase 1: Flood Modeling					**$110,500**
2D Floodplain Model Development					**$85,000**
Existing Conditions Survey	1	LS	$20,000	$20,000	
H&H Study	1	LS	$65,000	$65,000	
Contingency (30%)					**$25,500**
Phase 2: Natural Channel Design and Construction					**$321,854**
Natural Channel Design and Permitting					**$54,000**
Construction Administration and Oversight					**$15,000**
Access and Erosion/Sediment Control					**$23,100**
Confluence Realignment Construction					**$120,800**
Stakeout	1	LS	$15,000	$15,000	
As-Built Survey	1	LS	$15,000	$15,000	
Mobilization	1	LS	$9,000	$9,000	

ITEM/DESCRIPTION	QTY	UNIT	UNIT COST	ITEM SUB-TOTAL	EXTENDED SUB-TOTAL
Clearing	0.35	AC	$30,000	$10,500	
Excavation	500	CY	$30	$15,000	
Grading	0.7	AC	$9,000	$6,300	
Cross Vane	1	EA	$50,000	$50,000	
Planting					**$34,680**
Native Seed and Natural Fiber Matting	1,200	SY	$12	$14,400	
Live Stakes	500	EA	$10	$5,000	
Tubelings	1,910	EA	$8	$15,280	
Contingency (30%)					**$74,274**
TOTAL ESTIMATED BUDGET					**$432,354**

The table above presents the estimated costs in two phases. Phase 1 includes an existing condition survey and development of a 2D H&H model to evaluate flood risk and evaluate flood reduction options. Phase 2 assumes that survey information collected in Phase 1 is adequate to support design of natural channel based design. Anticipated permitting (VADEQ, USACE) as well as anticipated construction and planting efforts are also incorporated in the estimate.

Possible Alternatives and Additional Considerations

There are a number of alternative design solutions for this site along the confluence. The Town could consider raising the elevations of roads and bridges through this corridor. This project would require thorough coordination with VDOT and the railroad and would be anticipated to come with a large budget.

As noted above, the Town regularly experiences blocked routes due to stationary trains, which impact emergency services. The Buckingham Branch Railroad intersects Main Street/Route 39 Alt., eliminating a route of evacuation when it is blocked by train. The alternate route along Maury River Rd runs under the railroad at a close elevation to Mill Creek (**Figure 2**). Flows often overtop this low concrete bridge during floods, eliminating evacuation routes if both paths are blocked. Evacuation and emergency response are primary concerns at this site. The Town could coordinate with the railroad to ensure Route 39 Alt. is kept clear as often as possible and particularly moving trains prior to anticipated large storms or flood events.

Channel widening and deepening was discussed as a design alternative by Town officials. This solution might alleviate flooding over a short time period; however, this practice would also lead to increased deposition throughout the reach. Maintaining the channel would then require frequent dredging and consistent attention from Town officials. Furthermore, widening or deepening the channel has been noted by Town staff as being barred by the EPA; proceeding with this would require extensive permitting with the possibility of these permits being denied.

TMDL/MS4 Considerations

The Town of Goshen does not hold an MS4 permit, so formal stormwater permitting requirements were not factored when deciding upon designs for this project. Neither the Calfpasture River nor Mill Creek have developed TMDLs. However, the Calfpasture River eventually runs into Maury River, which has two approved TMDLs. The Maury River was listed as impaired due to water quality violations of the *E. coli* standard. A TMDL has also been developed for the Maury River due to PCB pollution. The work herein would not assist in the reduction of *E. coli* or PCBs entering the Maury River, likely providing no benefits toward TMDL goals.

Assumptions

Watershed (via StreamStats 9/3/2026) is 186 square miles from the confluence of the Calfpasture River and Mill Creek.

Construction estimated budget assumes adequate on-site material for re-working stream channel bed and only importing material for the single stone structure. Native plantings to stabilize the channel were estimated for 200 linear feet of along south bank of Mill Creek as well as 200 linear feet of the north bank.

Recommended Next Steps

Reach out to railroad to discuss options for keeping the Main Street intersection open for EMS traffic in the interim before H&H study can be prepared and options evaluated.

References

USGS. StreamStats v4.33.0. Accessed online 3 September 2026.

Virginia Tech Department of Biological Systems Engineering. 2013. Bacteria Total Maximum Daily Load Development for Colliers Creek, North Fork Buffalo Creek, South Fork Buffalo Creek, Buffalo Creek, Maury River and Cedar Creek and a Sediment Total Maximum Daily Load Development for Colliers Creek.

Virginia Tech Department of Biological Systems Engineering. 2025. PCB Total Maximum Daily Load Development for the Middle and Upper James River, Maury River, and Jackson River Watersheds

PROJECT IDENTIFICATION

TOWN OF GOSHEN

MILL CREEK BERM COMPLETION — PARTIAL ARMY CORPS OF ENGINEERS STRUCTURE

Location Description

37.988046, -79.498591

Along Mill Creek on the Virginia Avenue side of town, from behind the restaurant on Virginia Avenue to the old schoolhouse and continuing behind residential properties.

Project Issue

Incomplete flood protection structure — partial Army Corps earthen berm in its current unfinished state actively worsens flood recovery by trapping floodwater behind it after the river recedes; water enters through the open downstream end and cannot drain back to the river, extending inundation duration beyond what would occur without the berm. The berm was constructed after the 1985 flood with an unclosed gap at the downstream end just before meeting the Main Street/Virginia 39 Alt. bridge.

Project Purpose

Complete the earthen berm to close the downstream gap (**Figure 1**), converting the existing partial structure from net-negative to net-positive flood protection; include controlled drainage to allow any trapped water to drain back to the river when levels recede.

Identified Constraints

a. Within FEMA regulatory floodway
b. Coordination with USACE
c. Extent and condition of existing USACE berm
d. Coordination with VDOT for work around roads/bridges
e. Cooperation from private landowners or easement acquisition

Additional Information Needed

a. Dimensions and condition of current berm
b. USACE design study documentation for existing berm
c. Flood study to properly size berm

Project Proposal and Planning-Level Cost Estimate

Completion of the berm in this location would likely address the flooding, turning this area into a net-positive for flood protection. Work would include clearing the existing trees and shrubs from the corridor and placing soil for the earthen berm along Mill Creek to extend the existing berm

that was built by the Army Corps of Engineers (**Figure 2**). This berm should connect with the existing structure on the upstream extent, closing with the Main Street bridge downstream (**Figure 3**). This berm should then be planted with turfgrass to ensure stability of the embankment through floods and other flow conditions.

The Town has also raised concerns regarding water being trapped behind the berm without any outlet to drain back into Mill Creek. To alleviate this issue, a flap gate or other similar one-way drain structure should be installed towards the downstream end of the berm, where the elevation would be lowest behind the berm. Multiple dewatering structures could be incorporated into the design to offset the possibility of blockages and allow faster dewatering through multiple orifices.



Figure 1. Site map along Mill Creek marking the location of the existing and proposed berm, with other important features marked.



Figure 2. Downstream extent of the existing berm along Mill Creek, terminating behind picnic shelter. Private, informal extension of berm visible at lower elevation in the foreground. Photograph was taken facing approximately southwest.



Figure 3. Location of downstream extent of proposed berm. Main Street (Route 39 Alt) bridge is seen on the left, where the berm will tie in. Photograph was taken facing approximately southeast.

ITEM/DESCRIPTION	QTY	UNIT	UNIT COST	ITEM SUB-TOTAL	EXTENDED SUB-TOTAL
Floodplain Survey and Study					**$52,000**
Design and Permitting					**$54,000**
Construction Administration and Oversight					**$15,000**
Access and Erosion/Sediment Control					**$10,350**
Construction					**$132,450**
Stakeout	1	LS	$10,000	$10,000	
As-Built Survey	1	LS	$10,000	$10,000	
Mobilization	1	LS	$7,500	$7,500	
Grading-Fine	0.2	AC	$9,000	$1,800	
Fill	1800	CY	$50	$90,000	
Drain Pipe	105	LF	$60	$6,300	
Dewatering Inlet	3	EA	$150	$450	
Flap Gate	3	EA	$1,500	$4,500	
Permanent Seeding	10	LB	$10	$100	
Erosion Control Matting	900	SY	$2	$1,800	
Contingency (30%)					**$79,140**
TOTAL ESTIMATED BUDGET					**$342,940**

The table above presents estimated costs to complete a floodplain study and design and construct an extension to the existing berm.

Possible Alternatives and Additional Considerations

Alternative designs in this location are relatively limited. There is opportunity to elevate structures above the base flood elevation. The Town of Goshen could also consider relocating important infrastructure throughout this area outside of the floodplain. The existing berm could be dismantled to allow increased access to the floodplain along Mill Creek and eliminating the noted issue of flood waters being trapped behind the berm. Enhancing access to the floodplain through this corridor might work to reduce the severity of flooding experienced towards the confluence of Mill Creek and the Calfpasture River. This option, however, is anticipated to be more expensive than extending the berm, and it would require cooperation from a greater number of private landowners.

There are multiple alternatives for the design of the outlet/dewatering structure. Aside from various alternative gravity-driven outlets, a pump could be installed along the berm to remove any water that is trapped behind the embankment. When compared to the other outlet structures, the pump would allow flood water removal before the adjacent stream levels fall, but would require electricity, come at a higher cost, and require additional maintenance.

There is a partial berm on the southern bank of Mill Creek, which may warrant evaluation as part of this design process. Additional residences and the Goshen Public Library are located on the southern side of Mill Creek, between the creek and the railroad tracks.

TMDL/MS4 Considerations

The Town of Goshen does not hold an MS4 permit, so formal stormwater permitting requirements were not factored when deciding upon designs for this project. Neither the Calfpasture River nor Mill Creek have developed TMDLs. However, the Calfpasture River is a tributary to the Maury River, which has two approved TMDLs. The Maury River was listed as impaired due to water quality violations of the *E. coli* standard. A TMDL has also been developed for the Maury River due to PCB pollution. Completion of the berm is not expected to provide any benefits towards these TMDL goals.

Assumptions

Watershed of Mill Creek (via StreamStats 9/4/2026) is 45.3 square miles, taken from the Route 39 Alt bridge.

The existing berm is assumed to be of appropriate size and in good condition, not needing repair, though it should be fully inspected to verify this. The existing berm appears to be all soil; it is assumed that the extension would be all soil as well. Berm dimensions used for cost estimate are 325 lf, 25 ft wide, and 5 ft tall.

Recommended Next Steps

Reach out to USACE regarding design documentation of the existing berm.

References

USGS. StreamStats v4.33.0. Accessed online 4 September 2026.

Virginia Tech Department of Biological Systems Engineering. 2013. Bacteria Total Maximum Daily Load Development for Colliers Creek, North Fork Buffalo Creek, South Fork Buffalo Creek, Buffalo Creek, Maury River and Cedar Creek and a Sediment Total Maximum Daily Load Development for Colliers Creek.

Virginia Tech Department of Biological Systems Engineering. 2025. PCB Total Maximum Daily Load Development for the Middle and Upper James River, Maury River, and Jackson River Watersheds

PROJECT IDENTIFICATION

TOWN OF GOSHEN

WATER SYSTEM PUMP HOUSE FLOOD VULNERABILITY MITIGATION

Location Description

38.00061, -79.5236

Town water system pump house on Virginia Avenue just past the Route 600 intersection, immediately adjacent to Mill Creek in the floodplain; mobile home court located nearby.

Project Issue

Critical infrastructure flood vulnerability — pump house and inflow vault in the Mill Creek floodplain. Flood inundation of the site would contaminate the town's water supply inflow vault, trigger a boil water advisory, and risk sediment damage to the distribution system.

Project Purpose

Protect the town's water supply pump house and inflow vault from flood contamination; prevent boil water advisories and sediment damage to the distribution system during flood events.

Identified Constraints

a. Continued operation through design or construction
b. VDH Office of Drinking Water requirements

Additional Information Needed

a. Flood extents and severity

Project Proposal and Planning-Level Cost Estimate

The pump house is a critical piece of infrastructure that serves as the distribution system for all water system customers within the Town of Goshen. Due to its proximity to Mill Creek and its position in the floodplain, this infrastructure is vulnerable during intense storm events and severe floods. An H&H study should be conducted to identify the potential flood elevations on the site. The flood frequency or recurrence interval should be analyzed for inundation of the pump house to determine the current risk. It appears that the pump house property lies outside of the 1% annual chance flood zone (**Figure 1**); this would be corroborated with the results of the H&H study. The study would also identify the specific equipment vulnerable to identified floods. The Town has noted that the backup generator has been raised approximately five (5) feet, but the pump house and inflow vault are not elevated. Depending on the results of the study, further floodproofing measures may be warranted to ensure that service continues during severe flooding while preventing potential boil water advisories. An engineering report identifying the priority and

necessity of certain projects to protect the infrastructure could be created based on the results of the H&H study.

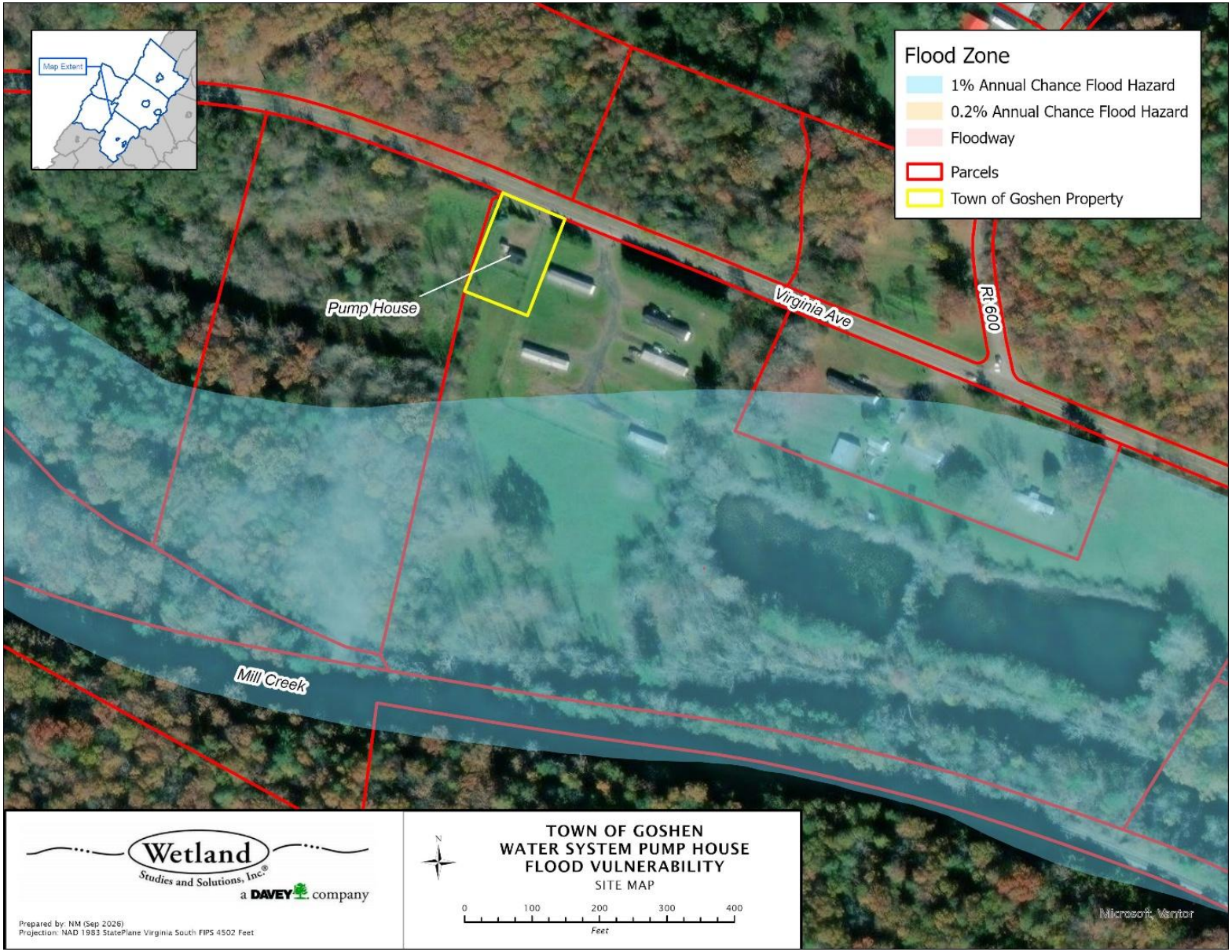

Figure 1. Site map displaying the pump house property and the modelled flood zones.

ITEM/DESCRIPTION	QTY	UNIT	UNIT COST	ITEM SUB-TOTAL	EXTENDED SUB-TOTAL
Flood Impact Study					**$80,000**
Existing Conditions Survey	1	LS	$20,000	$20,000	
H&H Study	1	LS	$30,000	$30,000	
PER	1	LS	$30,000	$30,000	
Contingency (30%)					**$24,000**
TOTAL ESTIMATED BUDGET					**$104,000**

The table above presents estimated costs for survey, H&H study and assessment of potential floodproofing efforts for the pump station. Should the survey verify that all necessary equipment is above the BFE, the decision to pursue H&H modeling and/or floodproofing measures can be evaluated for necessity. Estimation of costs associated with construction-phase efforts will require additional study and scoping.

Possible Alternatives and Additional Considerations

Based on the results of the flood impact study, a number of alternative actions could be taken to address flooding vulnerability in this area. Certain equipment may need to be elevated to prevent inundation, including electrical components, the inflow vault, or the entire pump house structure. These would come with varying costs and degrees of difficulty. Flood barriers and a flood door could be installed around the building to prevent floodwater from entering the building or contaminating the water. Alternatively, a berm or similar structure could be constructed around the site, providing protection during flooding. The Town has also noted that relocation of the entire facility as an alternative to best protect this infrastructure. Although this would eliminate the flooding concern, it could be the most complicated alternative, requiring construction and land acquisition elsewhere and operational continuity when switching between locations.

TMDL/MS4 Considerations

The Town of Goshen does not hold an MS4 permit, so formal stormwater permitting requirements were not factored when deciding upon designs for this project. Neither the Calfpasture River nor Mill Creek have developed TMDLs. However, the Calfpasture River is a tributary of the Maury River, which has two approved TMDLs. The Maury River was listed as impaired due to water quality violations of the *E. coli* standard. A TMDL has also been developed for the Maury River due to PCB pollution. Any of the proposed alterations or designs to the pump house would likely not provide pollutant reductions or TMDL benefits.

Assumptions

Watershed (via StreamStats 9/10/2026) is 43.3 square miles along Mill Creek.

Recommended Next Steps

Pursue survey of structures and equipment to evaluate elevation compared to BFE.

References

USGS. StreamStats v4.33.0. Accessed online 10 September 2026.

Virginia Tech Department of Biological Systems Engineering. 2013. Bacteria Total Maximum Daily Load Development for Colliers Creek, North Fork Buffalo Creek, South Fork Buffalo Creek, Buffalo Creek, Maury River and Cedar Creek and a Sediment Total Maximum Daily Load Development for Colliers Creek.

Virginia Tech Department of Biological Systems Engineering. 2025. PCB Total Maximum Daily Load Development for the Middle and Upper James River, Maury River, and Jackson River Watersheds

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